(NASA-CR-183426) MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE'S OPERATIONAL/DEVELOPMENT NETWORK (NODDNT) AT GODDARD SPACE FLIGHT CENTER Final Report (EER Technologies) 47 p

N89-25763

Unclas

CSCL 05A G3/81 0163874

RMS TECHNOLOGIES, INC.
8201 CORPORATE DRIVE SUITE 500 LANDOVER MARYLAND 20785
(301) 459-8981

October 31, 1988

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, MD 20771

Attention: Ms. Sandra McKercher
Contract Specialist
Code 285

Reference: Contract NAS5-30168

Dear Ms. McKercher:

In accordance with Article F-6, Reports of Work, attached please find the Final Report for the Mission Operations and Data Systems Directorate's Operational/Development Network (MODNET).

If you have any questions or suggestions regarding this report, please contact me at (301) 794-3408.

Very truly yours,

William I. Lawler
MODNET Project Manager

cc: Mr. Steven A. Smith (5)
Code 541.2

Date Submitted: October 31, 1988

Report No. 16

# FINAL REPORT

# FOR THE

# MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE'S

# OPERATIONAL/DEVELOPMENT NETWORK

# (MODNET)

# AT

# GODDARD SPACE FLIGHT CENTER

Contract No. NAS5-30168

RMS Technologies, Inc.
8201 Corporate Drive, Suite 500
Landover, Maryland 20785

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APPENDIX

A. MODNET HARDWARE/SOFTWARE DATA BASES

B. CABLE LAYOUT DIAGRAMS OF MODNET TRUNKS

## I. PROJECT MANAGEMENT

The Project Manager's efforts during the initial stage of the Mission Operations and Data Systems Directorate's (MO&DSD) Operational/Development Network (MODNET) contract focused on reviewing contract requirements and deliverables; establishing the office areas; and arranging for the acquisition of furniture, fixtures, equipment, and supplies necessary for contract startup.

He worked with Metro-Plex II building management to resolve initial office construction problems, and communicated with American Telephone and Telegraph Company (AT&T) to finalize the installation of voice and data telephone lines and equipment.

The Project Manager was responsible for the procurement of all equipment and supplies required for the timely implementation of the network, and spent a considerable amount of time compiling an extensive updated listing including the Government Services Administration (GSA) six percent discounted prices of the equipment to be purchased from Network Systems Corporation (NSC).

He established and conducted a weekly staff meeting as a forum for the review of work in progress, discussion of current problems and possible solutions, and formulation of plans for the future. All RMS MODNET personnel attended these Monday morning meetings.

He attended the biweekly MODNET Working Group (MODNETWG) meetings and completed designated action items. He also attended the Mid-Atlantic

Regional NSC User's Group (NEXUS) Conference that was held at the National Bureau of Standards in Gaithersburg, Maryland.

The Project Manager, in his role as Hardware System Engineer, attended an NSC E5000 Series Network Executive (NETEX) Software Course at the NSC Training Facility in Minneapolis, Minnesota. The E5000 Series course covered the NETEX family of software products and related HYPERchannel hardware, which included an indepth look at NETEX and Bulk File Transfer (BFX) plus associated hardware, usage, and design issues. Course Modules E5210 - NETEX for IBM MVS, E5211 - BFX for IBM MVS, and E5260 - NETEX for DEC VMS described how to use and install NETEX on the related system.

In addition to his role as Project Manager, he utilized his extensive hardware system engineering expertise to give direct hands-on support to the MODNET Hardware Engineering Technicians for installation and maintenance work being performed, acceptance testing of network adapters and associated equipment, and the development of data bases in addition to planning, scheduling, coordinating, and implementing the hardware installations for the following:

- Fourteen Network Adapter Systems including spare A901 and A223 Systems
- Eight Fiber Optic (FO) Repeaters including two spares
- All 1,624 feet of coaxial cable on eight floors of Buildings 3, 14, and 23 for the connection of 12 Adapter Systems with their HOST Systems to the completely new TESTLAN 2 Trunk

- The expansion of HIGHWAYS 0 Trunk with 926 feet of coaxial cable to accommodate connecting 10 additional Adapter Systems to this Trunk in Buildings 3 and 23
- The expansion of HIGHWAY 1 Trunk with 1,047 feet of coaxial cable to accommodate connecting 10 additional Adapter Systems to this Trunk in Buildings 3 and 23
- The expansion of InfoLAN 2 Trunk with 177 feet of coaxial cable to accommodate connecting three additional Adapter Systems to this Trunk in Building 23.
- The expansion of InfoLAN 3 Trunk with 489 feet of coaxial cable to accommodate connecting eight additional Adapters to this Trunk in Building 23.

He was also instrumental in the formulation of a plan for testing the fiber optic repeaters and cables, and the development of a Changeover Plan for the fiber optic repeaters and cables. Separate Changeover Plans for fiber optic cables and repeaters were developed for MODNET Highway Trunks 0 and 1, and for TESTLAN Trunk 2. The purpose of the Changeover Plans for Highway Trunks 0 and 1 was to document the actions to be taken to replace the aged and weathered interbuilding coaxial cable segments of the trunks with new, already in place and tested, fiber optic trunk segments. The purpose of the Changeover Plan for TESTLAN Trunk 2 was to document the actions that needed to be taken in order to link the two intrabuilding coaxial TESTLAN 2 sections via the interbuilding fiber optic TESTLAN section.

He was also responsible for the development of six data bases of MODNET hardware/software configuration information for use in system configuration management (refer to Appendix A) and the cable layout diagrams of the MODNET Trunks (refer to Appendix B).

The Project Manager significantly contributed to and extensively reviewed all contractually-required MODNET documentation.

Equipment Purchase Order (PO) activity during September 1988 consisted of the following:

- Purchase Order Number 18193 to Network Systems Corporation (NSC) which completes the procurement requirements for spare parts equipment and network monitoring software. (See Attachment 1.)
- Modification to PO Number 18109 for MODNET test equipment being purchased from Tektronix, Incorporated, after Tektronix added the equipment involved to their Goddard Space Flight Center (GSFC) discount list. (See Attachment 2.)
- Purchase of 3280 HEP Diagnostic Programs from Informax Data Systems, Incorporated (IDS). (See Attachment 3.)
- Purchase of 32/77 HEP Diagnostic Programs from IDS. (See Attachment 4.)

Figure 1 depicts the GSFC MODNET Milestone Schedule for the complete contract period.

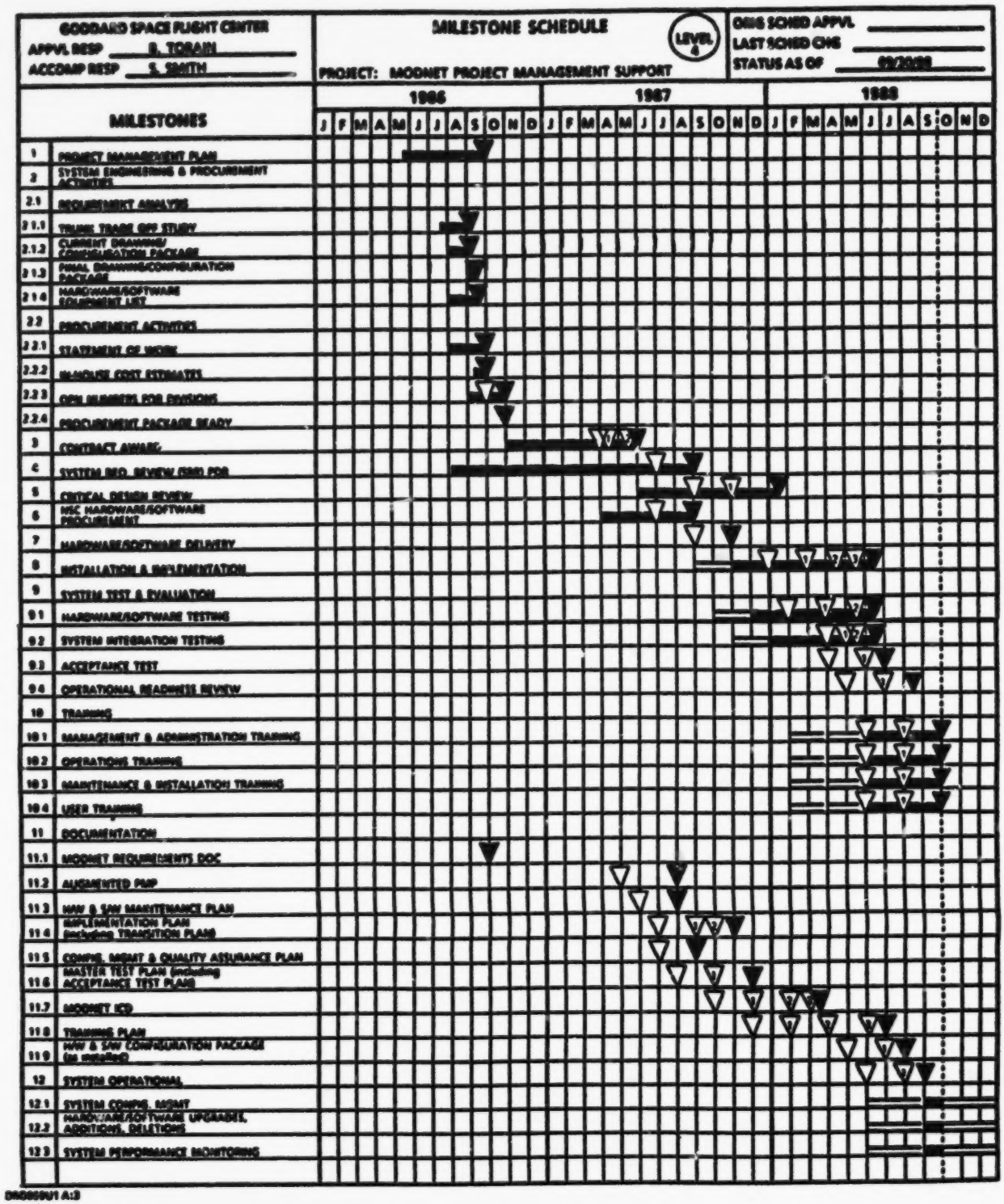
GODDARD SPACE FLIGHT CENTER
APPVL RESP S. TORAIN
ACCOMP RESP S. SMITH
MILESTONE SCHEDULE
LEVEL 4
PROJECT: MODNET PROJECT MANAGEMENT SUPPORT
OMS SCHED APPVL
LAST SCHED CHG
STATUS AS OF 09/30/88
MILESTONES
1986
1987
1988
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1 PROJECT MANAGEMENT PLAN
2 SYSTEM ENGINEERING & PROCUREMENT ACTIVITIES
2.1 REQUIREMENT ANALYSIS
2.1.1 TRADE OFF STUDY
2.1.2 CURRENT DRAWING/ CONFIGURATION PACKAGE
2.1.3 FINAL DRAWING/CONFIGURATION PACKAGE
2.1.4 HARDWARE/SOFTWARE EQUIPMENT LIST
2.2 PROCUREMENT ACTIVITIES
2.2.1 STATEMENT OF WORK
2.2.2 IN-HOUSE COST ESTIMATES
2.2.3 OPN NUMBERS FOR DIVISIONS
2.2.4 PROCUREMENT PACKAGE READY
3 CONTRACT AWARD
4 SYSTEM REQ. REVIEW (SRR) FOR
5 CRITICAL DESIGN REVIEW
6 MISC HARDWARE/SOFTWARE PROCUREMENT
7 HARDWARE/SOFTWARE DELIVERY
8 INSTALLATION & IMPLEMENTATION
9 SYSTEM TEST & EVALUATION
9.1 HARDWARE/SOFTWARE TESTING
9.2 SYSTEM INTEGRATION TESTING
9.3 ACCEPTANCE TEST
9.4 OPERATIONAL READINESS REVIEW
10 TRAINING
10.1 MANAGEMENT & ADMINISTRATION TRAINING
10.2 OPERATIONS TRAINING
10.3 MAINTENANCE & INSTALLATION TRAINING
10.4 USER TRAINING
11 DOCUMENTATION
11.1 MODNET REQUIREMENTS DOC
11.2 AUGMENTED PMP
11.3 HW & SW MAINTENANCE PLAN
11.4 IMPLEMENTATION PLAN (including TRANSITION PLAN)
11.5 CONFIG. MGMT & QUALITY ASSURANCE PLAN
11.6 MASTER TEST PLAN (including ACCEPTANCE TEST PLAN)
11.7 MODNET ICD
11.8 TRAINING PLAN
11.9 HW & SW CONFIGURATION PACKAGE (as installed)
12 SYSTEM OPERATIONAL
12.1 SYSTEM CONFIG. AUDIT
12.2 HARDWARE/SOFTWARE UPGRADES, ADDITIONS, DELETIONS
12.3 SYSTEM PERFORMANCE MONITORING
DRDSSSU1 A:3

Figure 1. GSFC MODNET Milestone Schedule



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## II. NETWORK HARDWARE/SYSTEMS ENGINEERING

During the initial stage of MODNET operations, the hardware engineering technicians assisted the RMS Technologies, Inc. (RMS) Engineering and Technical Support (ETS) personnel for Codes 520 and 550 in the performance of monthly and weekly preventive maintenance on network adapter units 10, 20, 30, 40, 50, 60, 70, and 90. They also responded promptly to users reporting problems with network adapters. However, during the period October 1987 through September of 1988, the RMS/MODNET hardware engineering personnel performed all preventive and remedial maintenance for the MODNET HIGHWAY, TESTLAN, and InfoLAN Trunks' Adapters.

The task of measuring and verifying trunk cable lengths and types of cables between the eight Mission Operations and Data Systems Directorate Network (MNET), three Information Processing Division Local Area Network (InfoLAN); and eight Mission Operations Division Local Area Network (MODLAN) adapter systems was completed. Both ends of the many different cables were relabeled as required. An inventory listing of all printed circuit boards (PCB) in all MNET, InfoLAN and MODLAN adapters was prepared. The list includes part numbers, serial numbers, and revision levels for all the PCBs.

The updated diagrams of the MODNET Functional Baseline Configuration and Operational Baseline Configuration, were completed. The task was complicated by many changes in trunk layout and host computer systems. The diagrams were updated throughout the term of the contract, and current revision

levels of the configuration diagrams are included as Figure 2 and Figure 3 of this report.

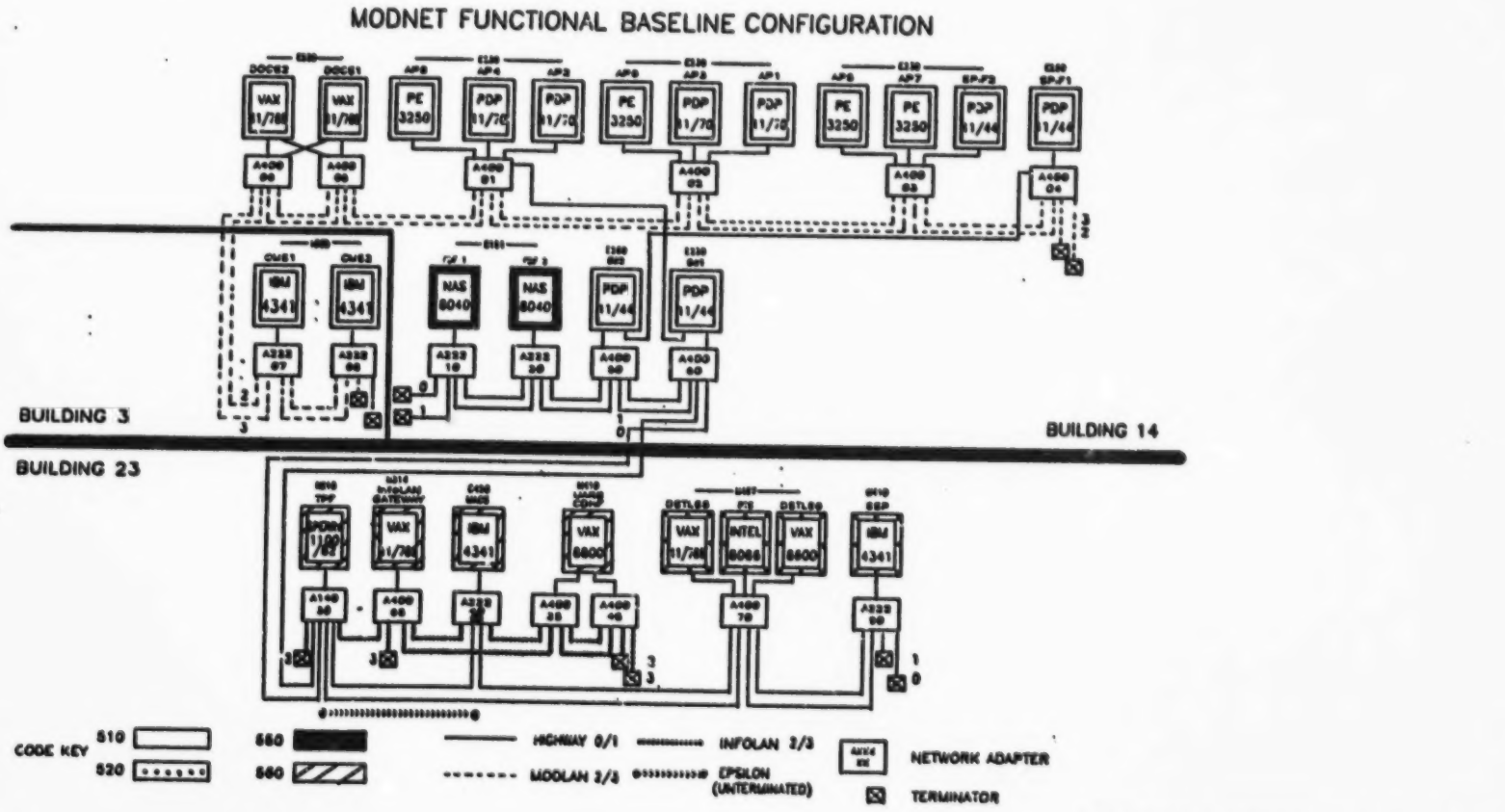


**Figure 2. MODNET Functional Baseline Configuration**

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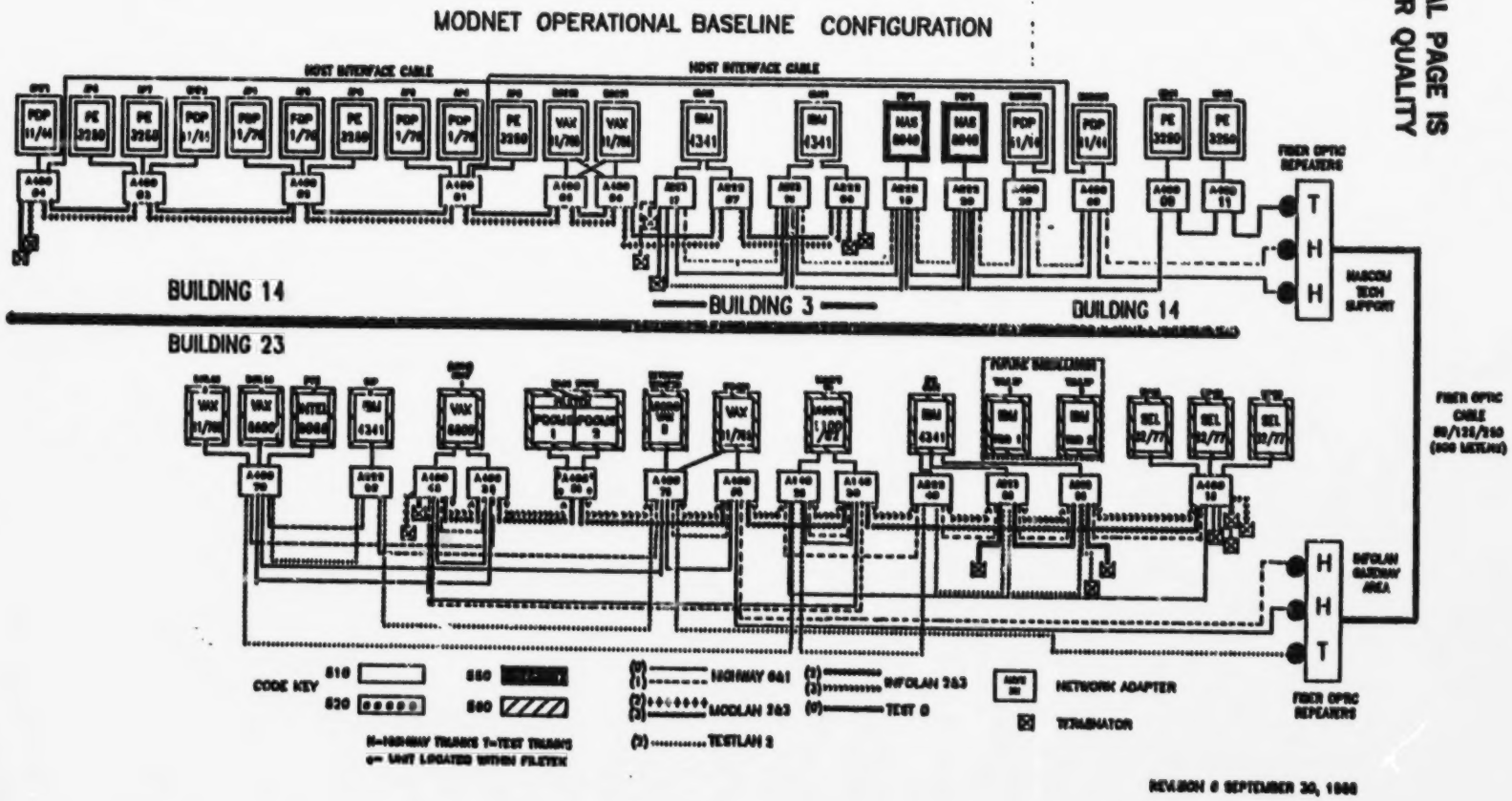


Figure 3. MODNET Operational Baseline Configuration

A member of the Network Hardware/Systems Engineering staff attended an NSC E1000 Hardware Maintenance Training Course in Minneapolis, Minnesota during the period of June 2 through June 11, 1987. Course material included functional descriptions of several adapters including A222, A400, A223, and A140; a brief explanation of board locations, registers, cables, and power supplies (positive and negative); instructions on the use of specialized test equipment including the NMC3 tester and PC terminal; and hands-on troubleshooting techniques. The course also covered the AC715 communications of the link, as well as the installation of all units.

An inventory checklist of the hardware and software that was being received from NSC was established and implemented. Part Numbers, NASA Numbers, Manufacturers' Serial Numbers, and Revision Levels were verified and documented. The inventory continued as additional equipment was received throughout the life of the contract.

Part Numbers, Revision Levels, and Serial Numbers for all PCBs in the existing network adapters were recorded and verified. PCBs for several adapters were not at current Revision Levels, and replacement of microcode was begun. Revision Levels of PCBs were modified in response to Field Change Orders (FCO).

The Hardware Engineering Technicians installed splices and ends on the new Comm/Scope trunks in Building 23 using 15 Comm/Comm splices, 18 Comm/N-type ends, and 2 N-type splices. In addition, drop cables were fabricated and Comm/Scope cables were installed with connectors in various

locations in Buildings 3, 14, and 23 as new trunk segments for the TESTLAN Trunk and as new expansion trunk segments for the two Highway Trunks.

ANDS and WRAP diagnostic testing was performed on System Development Facility network adapter units 9 and 11 to confirm proper operation for the scheduled fiber optic testing. All tests ran successfully. In addition, adapter units 9, 11, and 65 were used to test six ATR2 fiber optic repeaters using WRAP, HIT, and HEP diagnostics. All tests were completed without failure.

Three fiber optic trunk segments going between Buildings 14 and 23 were tested successfully utilizing a special test configuration of adapters 9 and 11 in Building 14 and adapter unit 65 in Building 23. The trunk segments were composed of fiber optic cable with ATR2 fiber optic repeaters at each end. A total of six ATR2 repeaters and three pairs of fiber optic cable were tested successfully with HEP and WRAP diagnostics running consecutively.

The Hardware Engineering Technicians worked with NSC personnel to perform the wiring, installation, and testing of 26 new AD8E trunk PCBs in 14 different network adapters.

All told, the RMS/MODNET hardware engineering personnel installed and/or reconfigured a total of 4,263 feet of coaxial trunk cable, 56 Adapter System connections to MODNET Trunks, 14 Network Adapter Systems and 8 FO Repeaters at GSFC in Buildings 3, 14, and 23 during the MODNET contract.

During September 1988, prior to receiving maintenance responsibilities for the MODLAN Adapter Systems, the RMS/MODNET engineering technicians

upgraded seven MODLAN A400 Adapter Systems (Unit 01 through 06 and the spare unit) as follows:

- On the AD7E Microprocessor Board P/N 200135-01, the A400 Microcode P/N 216091 was upgraded from revision level 42 to revision level 50.
- The AD5E Extension Register/DMA Board P/N 200166 was upgraded from revision level 03 to revision level 04.
- The AD400-2A Host Interface Board P/N 200020 was upgraded from revision level 02 to revision level 03.

After the upgrades were installed, each Unit was tested successfully with HEP diagnostics.

## III. NETWORK SOFTWARE/SYSTEMS ENGINEERING

The Network Software/Systems Engineering Section performed cost trade-off and design studies, software procurement, network software installation, test software development, and system integration/acceptance testing. These and installation of the NMS3 network monitor areas are discussed in the following sections.

Cost trade off/design studies: Three studies were performed by the Software/Systems Engineering Group:

- Software Lease vs. Purchase
- Gateway Replacement
- Network Monitoring

For the Software Lease vs. Purchase study, the Software Section used the GSA schedule to determine the lease and purchase costs of NETEX and BFX software for MODNET, including the one-time initial charge, for the projected 10-year life cycle of the Project. The multiple copy discount were included; free software maintenance in included with the lease. The purchase cost was based on the one-time purchase cost, including multiple copy discount, and a monthly software maintenance charge (CSS) for the 10-year period. The break-even point was in the 6th year, making the software purchase more cost effective.

In October 1987, the MODLAN subnetwork agreed to consider alternatives to the DEC PDP/11 Gateway computers that separate MODLAN from the MODNET subnetwork. The Software Section developed five alternate configurations using the NSC A710 and AC715 link adapters. These devices would provide message filters while providing high-speed communications between the subnetworks. After due consideration, MODLAN decided to keep the Gateway computers to provide complete electronic separation between the subnetworks and to route data traffic on the real-time and non-real-time sessions with the Flight Dynamics Facility (FDF).

In November and December 1987, a network monitor study was conducted to determine if the available network monitor satisfied the MODNET monitoring requirement and, if so, to schedule the purchase of the monitor. An earlier network monitoring study was obtained from the Defense Communication Agency (DCA) through the Local NEXUS organization. The MODNET study focused on the NSC NMS3 network management system and the HYPERtools Monitoring Device. The study concluded that the NMS3 provided the real-time monitoring support specified in the MODNET Requirements Document. The NMS3 was purchased with the understanding that NSC would be providing substantial functional and reporting features in the near future.

The HYPERtools analyzer was placed on the list of desirable future purchases. This analyzer provides an in-depth look at trunk performance and will be useful for future trunk usage and performance studies.

Software Procurement: Upon completion of the Lease vs. Purchase study, a purchase order for 30 NETEX and 18 BFX products was submitted. This procurement included NETEX and BFX for IBM MVS, DEC PDP, DEC VAX, UNISYS 1100, Perkin-Elmer 3250, and Gould SEL 32/77 computers. The NETEX purchase for all except IBM and UNISYS included Driver software.

The delivered software included base tapes and service level tapes for each product, as well as the general purpose manual which is delivered with each product. NSC also authorized GSFC/RMS to make duplicate copies of these manuals for the purpose of developing a MODNET library. All products and service levels were recorded in the MODNET software database.

Network Software Installation: NETEX and BFX were installed on each host system by the MODNET software engineer and the designated systems programmer for each host. This combination proved successful in combining NETEX and local system knowledge. As each system was installed, it was tested using BFX for both intrahost and interhost tests.

NETEX and BFX on IBM hosts were installed using SMP/4, SMP/E, or load module transfer. DEC VAX hosts proved the easiest to install, although the accidental deletion of an empty data set caused delays in one VAX installation. The Gould SEL computers have a Level-1 NETEX which is delivered as a subroutine library. This NETEX/BFX was easily installed but required an extensive effort to get it to work.

Due to the size of the network, a master network control table (NCT) was developed to verify the connectivity of all hosts. The operational NCT was tailored from the master NCT to reflect only those remote hosts with which each host will communicate.

Test Software Development: The MODNET programmer/analyst developed two test programs to test and demonstrate satisfaction of the MODNET performance and session capacity requirements. The SINGLE program opened one session and transferred data to a matching SINGLE program on the same host or another host. The tester responded to menus to specify the number and size of records to be transmitted and the number of iterations of the test to be performed. Test results were printed at the terminal and/or to a test log.

The test program MULTPL opened 28 sessions between 2 copies of the test program on the same or remote hosts. As with the SINGLE program, the tester was prompted for number of records, record size, and iterations. The aggregate test results and results for each session were printed at the terminal.

BFX was also used for performance testing using a file of 1,000 records of 4,068 bytes in length. The 4,068 byte length was selected due to the 28-byte BFX overhead and the 4,096-byte buffer size used for network testing.

Systems Integration/Acceptance Testing: Initial systems integration testing was performed using BFX on all hosts to establish and confirm connectivity between hosts. Performance testing was initially performed as planned with the SINGLE program with parallel testing with BFX. Due to subsequent problems in testing the 28-session capacity tests, the remaining performance tests were completed using BFX. A test matrix was developed to record performance tests between each host and all other hosts.

Although the requirement was simply to demonstrate that each host NETEX could achieve 500 kilobits per second, this extended test was selected to demonstrate the stability and robustness of the network.

After extensive program changes to the MULTPL program, it was determined that NETEX buffer and control region resources were the major cause of the capacity test failures. By modifying the NETEX parameters on each host, the capacity tests were successfully completed on all hosts that permitted the parameter changes. The result of this change was a substantial increase in the amount of real memory used by NETEX. The NETEX region size on the IBM hosts increased to 2.5 Megabytes. All parameters were restored to their original values after completion of the capacity tests.

Acceptance testing was completed with a stress test in which over 1,000 sessions were opened and 1,000,000 records were transmitted in 3-1/2 hours. This test demonstrated the robustness of the network.

Network Monitor Installation: The Software Section was also responsible for the installation and testing of the NMS3 network monitor. The NMS3 was physically installed by NSC and RMS maintenance personnel. NSC personnel installed the network monitor software. The Software Section worked with NSC personnel to develop the monitor NCT and the monitor configuration file which produces the Graphics Display Facility (GDF) display on the Tektronix 4105A display screen. The initial monitor software was Release 1.01 which is a Level-1 NETEX. In September 1988, NSC installed Release 1.10 which is a Level-2 NETEX. The monitoring software provides an accurate status of the network, althcugh the recently installed Release 1.10 does appear to have some errors. This Release was initially installed as a pre-release with patches installed by NSC. The production release will be installed when available, and the monitor will be re-evaluated.

## IV. DOCUMENTATION

Immediately after contract startup, the Documentation Specialist reviewed the list of contractually-required deliverables for the term of the contract, set up the work area, and established MODNET Documentation Procedures.

The MODNET Work Breakdown Structure (WBS) was updated to reflect modifications in the four functional areas.

A MODNET Hardware Service Report for use by the Hardware Engineering Technicians to record installation, modification, maintenance, and testing activities was designed and produced in multiparts on carbonless paper. A MODNET Software Service Report was prepared for use by Software Systems Engineering personnel.

The Documentation Section provided support throughout the life of the contract in the areas of writing, editing, and graphics in preparation of the following documents and reviews:

- Augmented Project Management Plan
- Hardware and Software Maintenance Plan
- Configuration Management and Quality Assurance Plan
- Implementation and Transition Plan

- System Requirements Review/Preliminary Design Review (SRR/PDR)
- Preliminary Design Document
- Critical Design Review
- Critical Design Document
- Master Test Plan with Acceptance Test Plan
- Operational Readiness Review
- Training Plan
- Interface Control Document
- Detailed Design Document
- Acceptance Test Procedures and Acceptance Test Report
- BFX Training Class Materials
- NMS3 Training Class Materials

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# ATTACHMENT 1

PURCHASE ORDER

38193

DATE 9/22/88

REQ # 3810

# TECHNOLOGIES, INC.

8201 Corporate Drive • Suite 900
Landover, Maryland 20785
(301) 459-8991

| ACCT. NUMBER | DEPT. — ACCT NO. |
|---|---|
| 832.30.0000.631 | 310 |

SELLER:

Network Systems Corporation
501 Church Street, N.E., Suite 200
Vienna, VA 22180
ATTN: Mr. Dennis Robertson

SHIP TO: (IF NOT ABOVE ADDRESS)

Receiving Officer, Bldg. 16
Goddard Space Flight Center
Greenbelt, Maryland 20771
MARK FOR: Steven A. Smith, Code 541.2
Contract No. NAS5-30166

Items 1 thru 4 to be purchased at GSA Discount Prices

| SHIP | F.O.B. | TERMS | DELIVERY REQUIRED |
|---|---|---|---|
| best way | delivered | N/30 | asap |

| DELIVER TO: | GENERAL DESCRIPTION | QUANTITY—1 SMALL EXPENSE—2 OTHER—3 |
|---|---|---|
| MARK FOR: Steven A. Smith, Code 541.2 | NSINET CONTRACT | |

SELLER SHALL RETURN ACKNOWLEDGEMENT OF ORDER, GIVING SHIPMENT & PROMISED DATE.

| ITEM NO. | QUANTITY | UNIT | DESCRIPTION | | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|---|
| 1 | 4 | ea | A250 | Trunk Expansion | $4,329.00 | $17,316.00 |
| 2 | 2 | ea | C223-1 | A222 to A223 Conversion | $1,380.00 | 2,760.00 |
| 3 | 1 | ea | CN135 | Network Administrator | 13,340.30 | 13,340.00 |
| 4 | 2 | sets | PZ17-6 | PZ Extension Cables | 754.00 | 1,508.00 |
| 5 | 2 | sets | 301419-mx | Cable Assy., Interconnect | 650.00 | 1,300.00 |

Terms and conditions on the reverse side of this PO are deleted.

GSA terms and conditions will be the controlling terms.

Items 2 and 3 should be installed by NSC within 30 days after they are received at GSFC.

W H Cowles

TOTAL ▶ $36,224.00

SELLER SHALL:
1) ACKNOWLEDGE RECEIPT OF THIS ORDER IMMEDIATELY
2) INCLUDE PACKING SLIP WITH EACH SHIPMENT
3) MAIL SHIPPING NOTICE TO SHIPPING DEPT.
4) PUT PURCHASE ORDER NUMBER ON ALL PACKAGES, PACKING SLIPS, BILLS OF LADING, AND INVOICES
5) MAIL ALL INVOICES TO THE PURCHASE ACCOUNTS PAYABLE DEPT. AT ABOVE ADDRESS

NOTICE TO BE VALID, A PURCHASE ORDER TOTALING $50,000 OR MORE MUST BE COUNTERSIGNED BY THE DIRECTOR OF CONTRACTS.

PURCHASING AGENT

DIRECTOR OF CONTRACTS

SELLER COPY

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# ATTACHMENT 2

PURCHASE ORDER

**TECHNOLOGIES, INC.**

6801 Corporate Drive • Suite 860
Landover, Maryland 20785
(301) 459-8981

DATE 9/29/88
REQ # 4389

SELLER:

Schramin, Inc.
700 Professional Drive
Gaithersburg, MD 20877

Attn: Beverly Ryan

TERMS—SUBTASK 439-30-0000-001 | DEPT—ACCT NO. 332

SHIP TO: (IF NOT ABOVE ADDRESS)

Receiving Officer, Bldg. 26
Goddard Space Flight Center
Greenbelt, Maryland 20771
MARK FOR: Steven A. Smith, Code 541.2
Contract No. NAS5-30160

| SHIP | F.O.B. | VENDOR | REQUIRED DELIVERY |
|---|---|---|---|
| Best way | Shipment | N/A | ASAP |

| DELIVER TO: | MATERIAL DESCRIPTION | QUANTITY—1 SMALL BUSINESS—2 OTHER—0 |
|---|---|---|
| MARK FOR: Steven A. Smith, Code 541.2 | REVISE Contract NAS5-30160 | |

SELLER SHALL RETURN ACKNOWLEDGMENT AT ONCE, GIVING DEFINITE SHIPPING DATE

| NO. | QUANTITY | UNIT | DESCRIPTION | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| | | | Value of Original Purchase Order 328169 | | $8,881.50 |
| | | | Modification 01 | | |
| | | | Addition - | | |
| | | | GSFC Discount 5.00% | | $399.68 |
| | | | Net Increase to original Purchase Order 328169 is $399.68. | | |
| | | | This order is placed under written authorization from NAS5 dated June 8, 1988. In the event of any inconsistency between the terms and conditions of this order and those of your Federal Supply Schedule contract, or Personal Property Rehabilitation Price Schedule contract, the latter will govern. | | |
| | | | | TOTAL ▶ | $8,781.82 |

SELLER SHALL:
1) INVOICE IN TRIPLICATE UNLESS OTHERWISE SPECIFIED
2) INCLUDE PACKING SLIP WITH EACH SHIPMENT
3) MAIL SHIPPING NOTICE TO SHIPPING DEPT.
4) PUT PURCHASE ORDER NUMBER ON ALL PACKAGES, PACKING SLIPS, BILLS OF LADING, AND INVOICES
5) MAIL ALL INVOICES TO: TRIFOOS ACCOUNTS PAYABLE DEPT. AT ABOVE ADDRESS

NOTICE: TO BE VALID, A PURCHASE ORDER TOTALING $50,000 OR MORE MUST BE COUNTERSIGNED BY THE DIRECTOR OF CONTRACTS.

PURCHASING AGENT

DIRECTOR OF CONTRACTS

RECEIVING COPY

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## ATTACHMENT 3

PURCHASE ORDER

**nms TECHNOLOGIES, INC.**

8201 Corporate Drive • Suite 880
Landover, Maryland 20785
(301) 459-8181

30216

DATE 9/30/88

REQ # 6305 and 6306

SELLER:

Informex Data Systems, Inc.
5933 W. Century Blvd., Suite 630
Los Angeles, CA 90045
ATTN: David R. Brown

| TERMS—DISCOUNT | DEPT—ACCT NO. |
|---|---|
| 612.40.6000.693 | 332 |

SHIP TO: (IF NOT ABOVE ADDRESS)

Receiving Officer, Bldg. 16
Goddard Space Flight Center
Greenbelt, Maryland 20771
MARK FOR: Steven A. Smith, Code 541.2
Contract No. NAS5-30160

| SHIP | F.O.B. | TERMS | REQUIRED DELIVERY |
|---|---|---|---|
| best way | delivered | n/30 | asap |

| DELIVER TO: | ORIGINAL DESCRIPTION | ORIGINAL—1 CANCELLATIONS—2 OTHER—3 |
|---|---|---|
| MARK FOR: Steven A. Smith, Code 541.2 | NCSERT Contract NAS5-30160 | |

SELLER SHALL RETURN ACKNOWLEDGMENT AT ONCE, GIVING DEFINITE SHIPPING DATE

| NO. | QUANTITY | UNIT | DESCRIPTION | UNIT PRICE | AMOUNT |
|---|---|---|---|---|---|
| 1 | 6 | ea | 3280 HEP Diagnostic Program for running Hyper-channel Exerciser Program (HEP) on NSC Model A400 Adapter Systems from Concurrent Computer Corporation - Perkin Elmer Model 3250 and 3280 computer systems, as per Informex Data Systems, Inc. (IDS) letter L-3766, dated 16 September 1988 and NSC HEP Design Specification Document-420990400. In addition, the 3280 HEP must be compatible with the PASCAL compiler currently installed on the GSFC Code 510 Perkin-Elmer computers. | $4,000.00 | $24,000.00 |
| 2 | 6 | ea | Installation charge- The installation charge is limited to $1,800.00 (5 days). Any costs over this must be borne by IDS. | $300.00 | $1,800.00 |
| 3 | 6 | ea- | Product Maintenance- 1 year<br>The Product Maintenance fee for 5 years is called out in letter L-3766. Only one year of maintenance will be purchased, at this time. The remaining 4 years of maintenance will be negotiated on an annual basis between NASA/GSFC or their contractor representative and IDS. | $400.00 | $2,400.00 |
| | | | | TOTAL ▶ | $28,200.00 |

W. Hawkes

SELLER SHALL:
1) INVOICE IN TRIPLICATE UNLESS OTHERWISE SPECIFIED.
2) ENCLOSE PACKING SLIP WITH EACH SHIPMENT.
3) EMAIL SHIPPING NOTICE TO SHIPPING DEPT.
4) PUT PURCHASE ORDER NUMBER ON ALL PACKAGES, PACKING SLIPS, BILLS OF LADING, AND INVOICES.
5) MAIL ALL INVOICES TO: TECHNICAL ACCOUNTING PAYABLE DEPT, AT ABOVE ADDRESS.

NOTICE: TO BE VALID, A PURCHASE ORDER TOTALING $25,000 OR MORE MUST BE COUNTERSIGNED BY THE DIRECTOR OF CONTRACTS.

PURCHASING AGENT

DIRECTOR OF CONTRACTS

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ATTACHMENT 4

PURCHASE ORDER

**RMS TECHNOLOGIES, INC.**

8201 Corporate Drive • Suite 900
Landover, Maryland 20785
(301) 459-8201

10717

DATE 3/28/88

REQ # 4309

SELLER:

Informax Data Systems, Inc.
5013 W. Century Blvd., Suite 610
Los Angeles, CA 90045

ATTN: Mr. David Brown

| PRICE/ACCTG | DEPT—ADDT'NL |
|---|---|
| 512.40.0000.621 | 212 |

SHIP TO: (IF NOT ABOVE ADDRESS)

Receiving Officer, Bldg. 16
Goddard Space Flight Center
Greenbelt, Maryland 20771
MARK FOR: Steven A. Smith, Code 561.2
Contract No. NAS5-30168

| SHIP | F.O.B. | TERMS | REQUIRED DELIVERY |
|---|---|---|---|
| best way | delivered | n/30 | asap |

| DELIVER TO: | GENERAL DESCRIPTION | |
|---|---|---|
| MARK FOR: Steven A. Smith, Code 561.2 | HOMER Contract NAS5-30168 | MINORITY—1 SMALL BUSINESS—1 OTHER—0 ☐ |

SELLER SHALL RETURN ACKNOWLEDGMENT AT ONCE, GIVING DEFINITE SHIPPING DATE.

| ITEM NO. | QUANTITY | UNIT | DESCRIPTION | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| 1 | 3 | ea | 32/77 HEP Diagnostic Program for running Hyperchannel Exerciser Program (HEP) on HSC Model A400 Adapter System from Gould : Model SEL 32/77 Computer Systems, as per Informax Data Systems, Inc. (IDS) letter L-3766, dated 16 September 1988 and HSC HEP Design Specifications Document - 430990498. | $4,000.00 | $12,000.00 |
| 2 | 3 | ea | Product Maintenance for 5 years | | No Charge |
| 3 | 3 | ea | Engineering (NRE) | $3,642.16 | $10,926.48 |
| 4 | 3 | ea | Installation charge- The installation charge is limited to $1,800.00 (5 days). Any costs over this must be borne by IDS. | $600.00 | $1,800.00 |
| | | | | TOTAL ▶ | $24,726.48 |

THIS CONTRACT (PURCHASE ORDER) IS SUBJECT TO THE PROVISIONS ON BOTH SIDES AND ANY ATTACHMENTS HERETO UNLESS OTHERWISE AGREED ABOVE

SELLER SHALL:
1) INVOICE IN TRIPLICATE UNLESS OTHERWISE SPECIFIED
2) INCLUDE PACKING SLIP WITH EACH SHIPMENT
3) MAIL SHIPPING NOTICE TO SHIPPING DEPT.
4) PUT PURCHASE ORDER NUMBER ON ALL PACKAGES, PACKING SLIPS, BILLS OF LADING, AND INVOICES
5) MAIL ALL INVOICES TO: INVOICE ACCOUNTS PAYABLE DEPT. AT ABOVE ADDRESS

NOTICE: TO BE VALID, A PURCHASE ORDER TOTALING $25,000 OR MORE MUST BE COUNTERSIGNED BY THE DIRECTOR OF CONTRACTS.

PURCHASING AGENT

DIRECTOR OF CONTRACTS

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# Report Documentation Page

| 1. Report No. | 2. Government Accession No. | 3. Recipient's Catalog No. |
|---|---|---|
| 16 | | |

| 4. Title and Subtitle | 5. Report Date |
|---|---|
| Final Report for the Mission Operations & Data Systems Directorate's Operational Development Network (MODNET) at Goddard Space Flight Center | October 31, 1988 |
| | 6. Performing Organization Code |

| 7. Author(s) | 8. Performing Organization Report No. |
|---|---|
| RMS Technologies, Inc.<br>8201 Corporate Drive<br>Landover, MD 20785 | |
| | 10. Work Unit No. |
| 9. Performing Organization Name and Address | |
| RMS Technologies, Inc.<br>8201 Corporate Drive<br>Landover, MD 20785 | 11. Contract or Grant No.<br>NAS5-30168 |
| | 13. Type of Report and Period Covered<br>Final Report<br>June 1, 1987-Sept. 30, 1988 |
| 12. Sponsoring Agency Name and Address | 14. Sponsoring Agency Code |
| National Aeronautics and Space Administration<br>Washington, D.C. 20546-0001<br>Goddard Space Flight Center<br>Greenbelt, MD 20771 | |

15. Supplementary Notes

16. Abstract

This report provides a brief, informal narrative that summarizes the results of all work accomplished during the period of the contract; June 1, 1987 through September 30, 1988; in support of MODNET. It includes descriptions of work performed in each functional area and recommendations and conclusions based on the experience and results obtained.

| 17. Key Words (Suggested by Author(s)) | 18. Distribution Statement |
|---|---|
| | Unclassified-Unlimited |

| 19. Security Classif. (of this report) | 20. Security Classif. (of this page) | 21. No. of pages | 22. Price |
|---|---|---|---|
| Unclassified | Unclassified | 25 | |

NASA FORM 1626 OCT 86

# APPENDIX A

## MODNET HARDWARE/SOFTWARE DATA BASES

# APPENDIX B

## CABLE LAYOUT DIAGRAMS OF MODNET TRUNKS

# Mission Operations and Data Systems Directorate's (MO&DSD)

# Operational/Development Network (MODNET)

**MODNET Trunks**
**Cable Layout Diagrams**
**Building 03**
**Building 14**
**Building 23**

**September 1988**

# MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE'S (MO&DSD)

# OPERATIONAL/DEVELOPMENT NETWORK (MODNET)

# MODNET TRUNKS CABLE LAYOUT DIAGRAMS

September 1988

Prepared for
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

In Response To
Contract No. NAS5-30163

Prepared by
RMS Technologies, Inc.
8201 Corporate Drive
Landover, Maryland 20785

# MODNET CABLE

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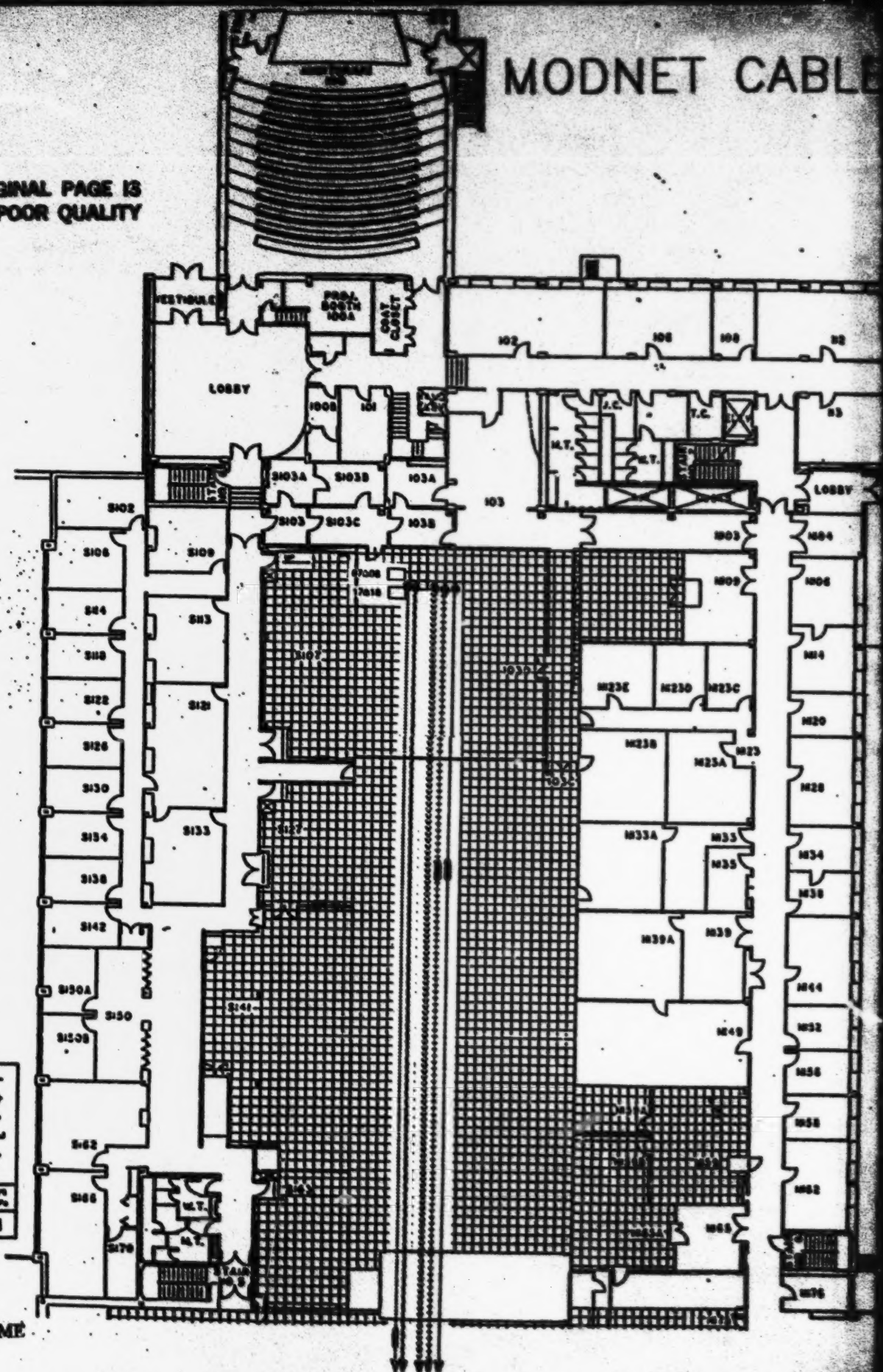
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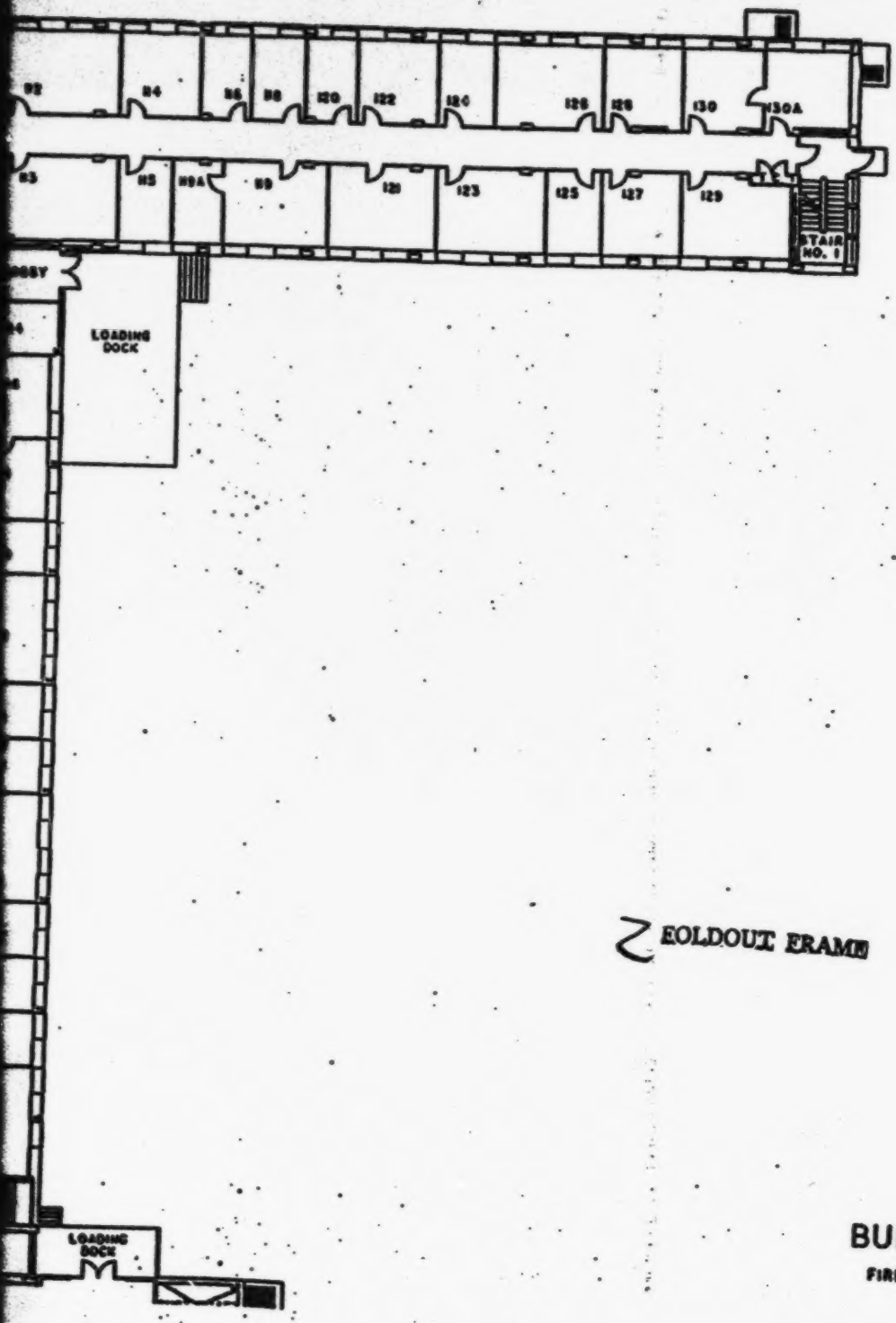


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BUILDING 3

FIRST FLOOR PLAN

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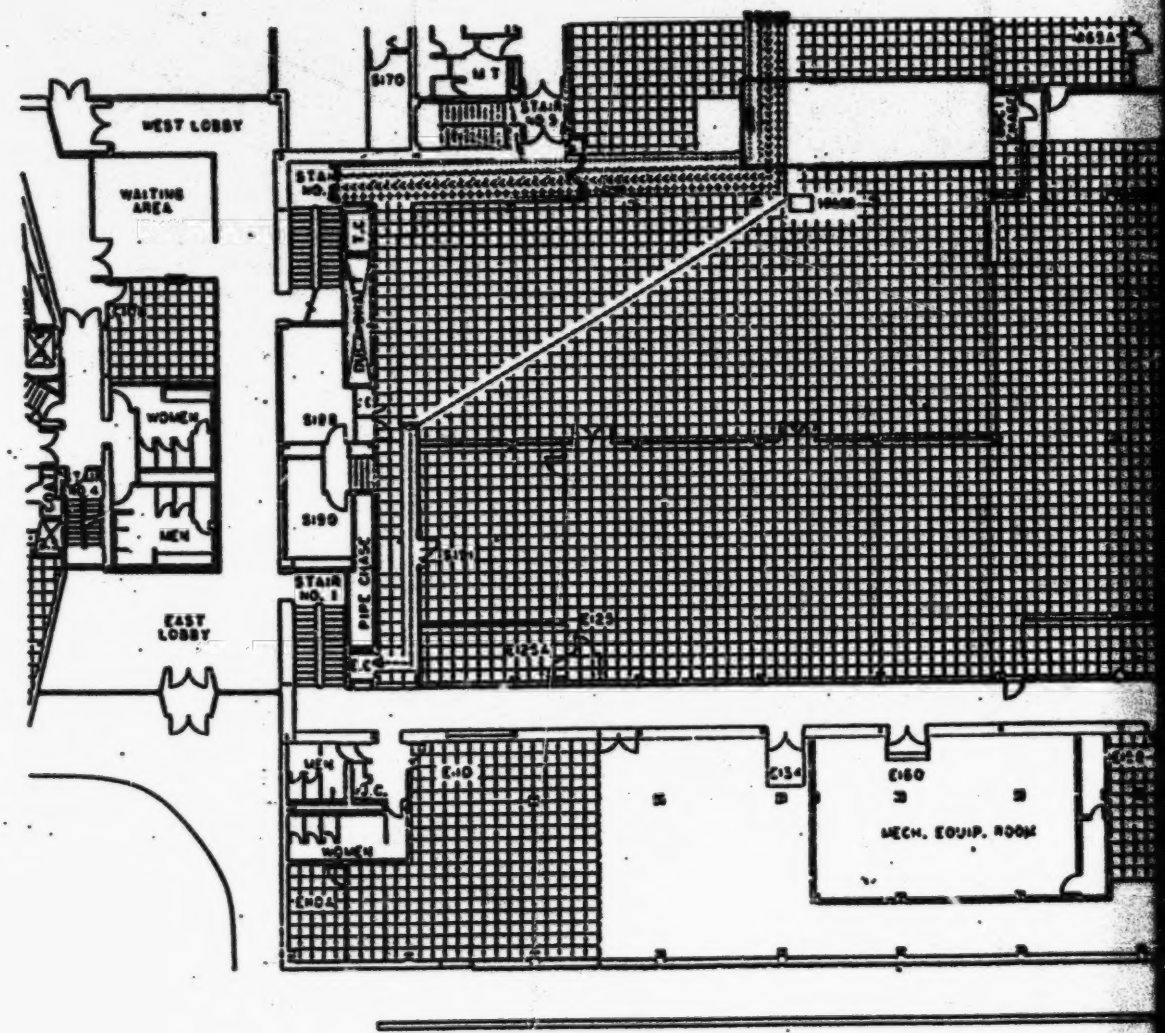


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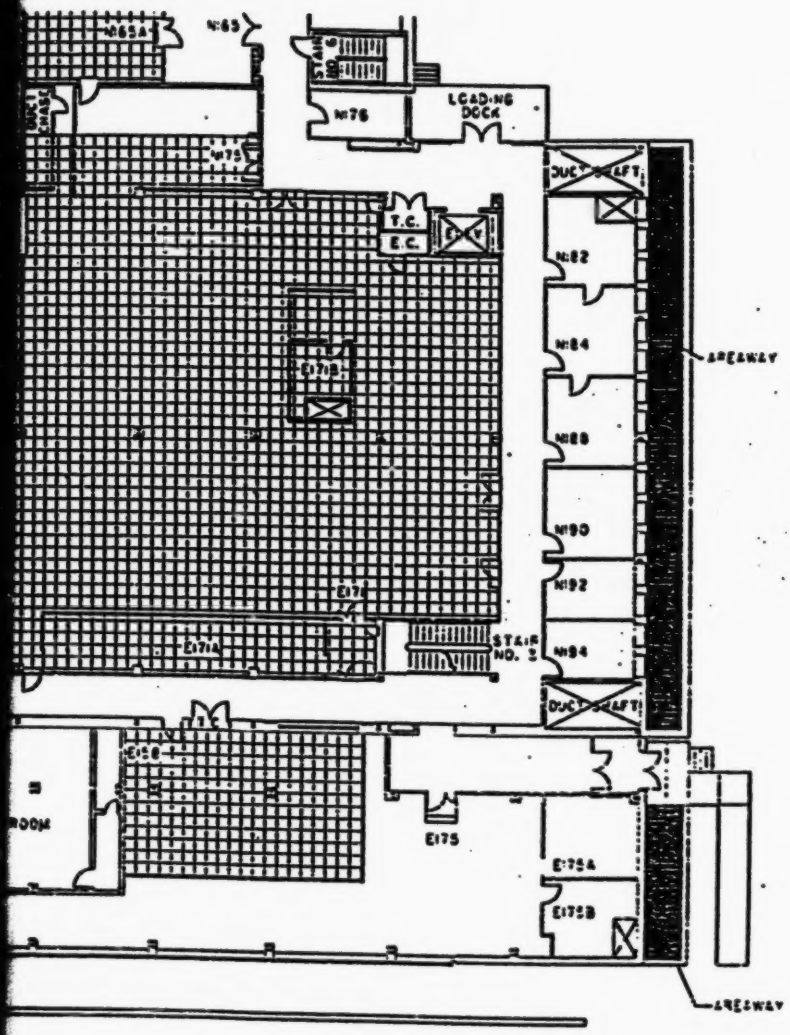


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## BUILDING 14

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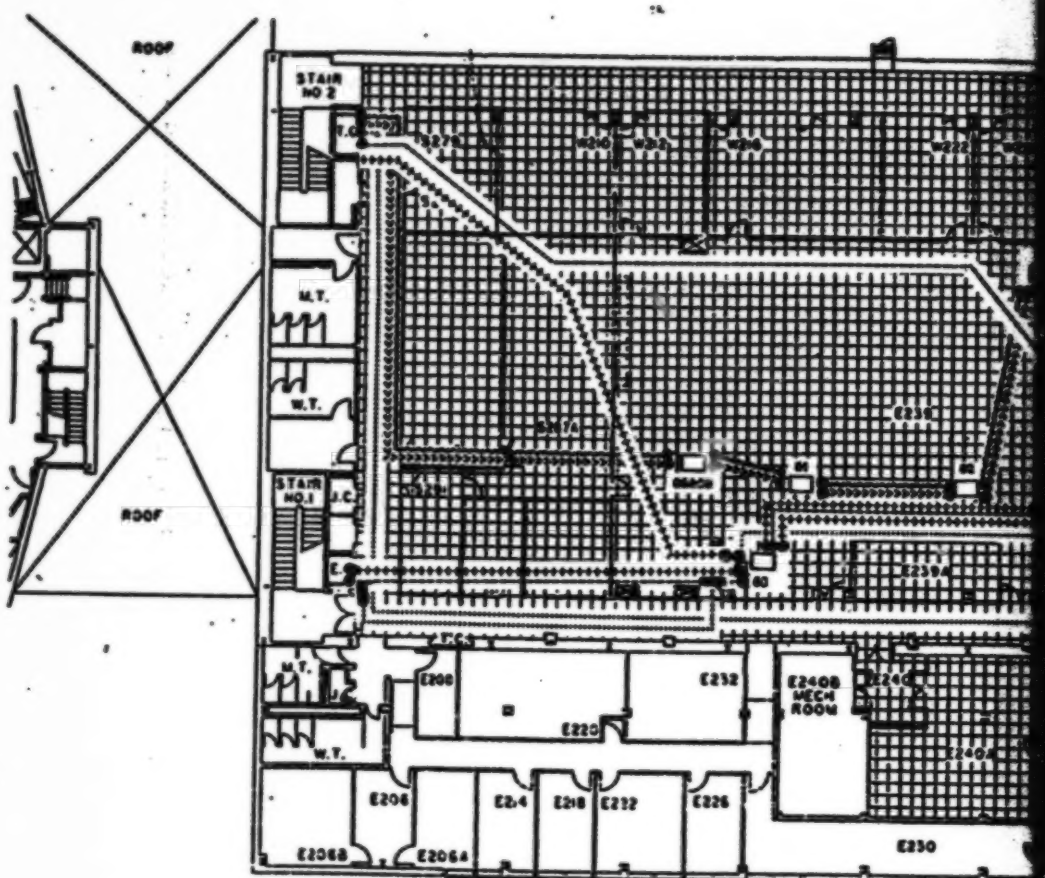


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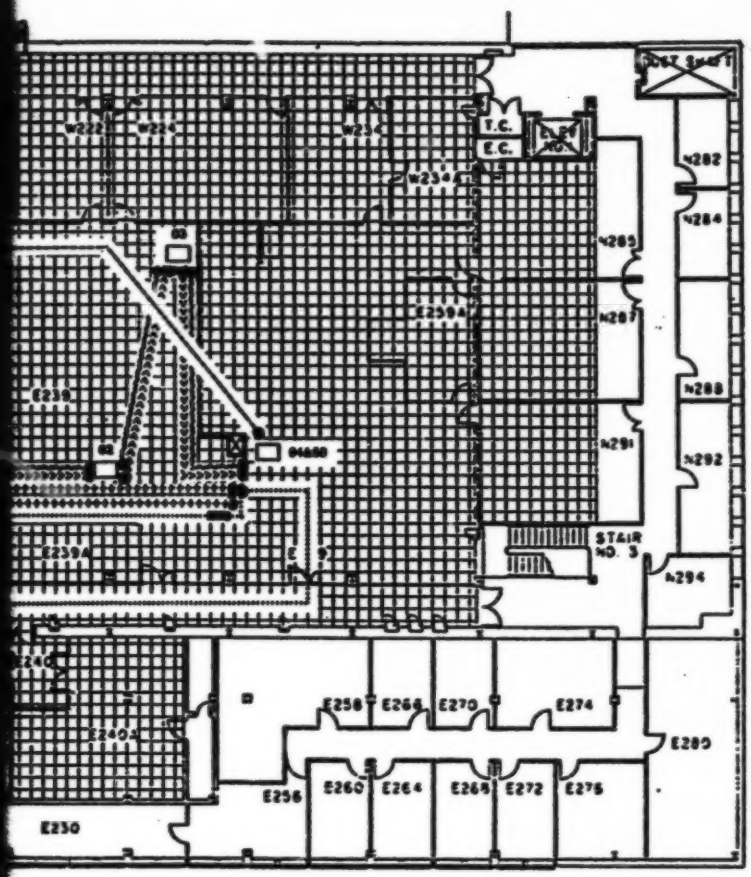


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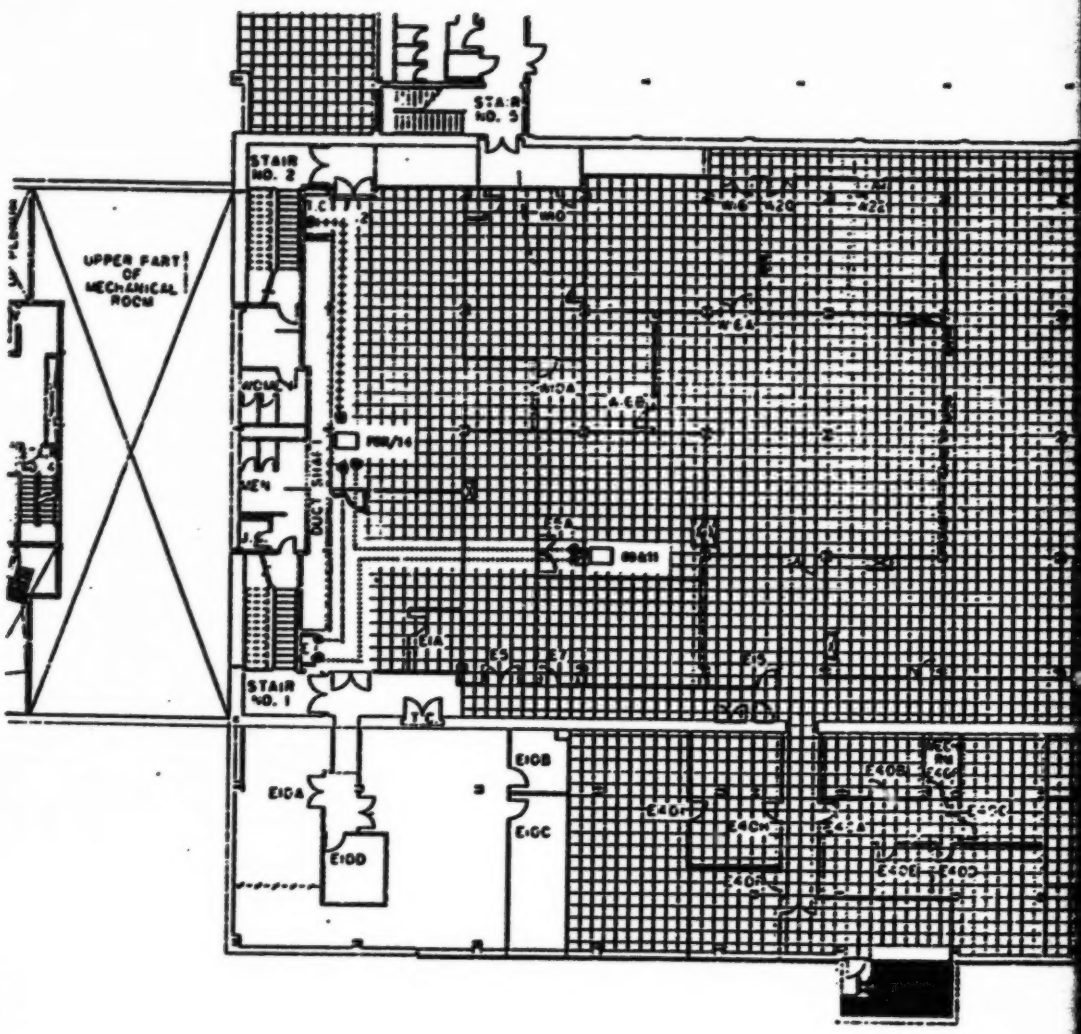


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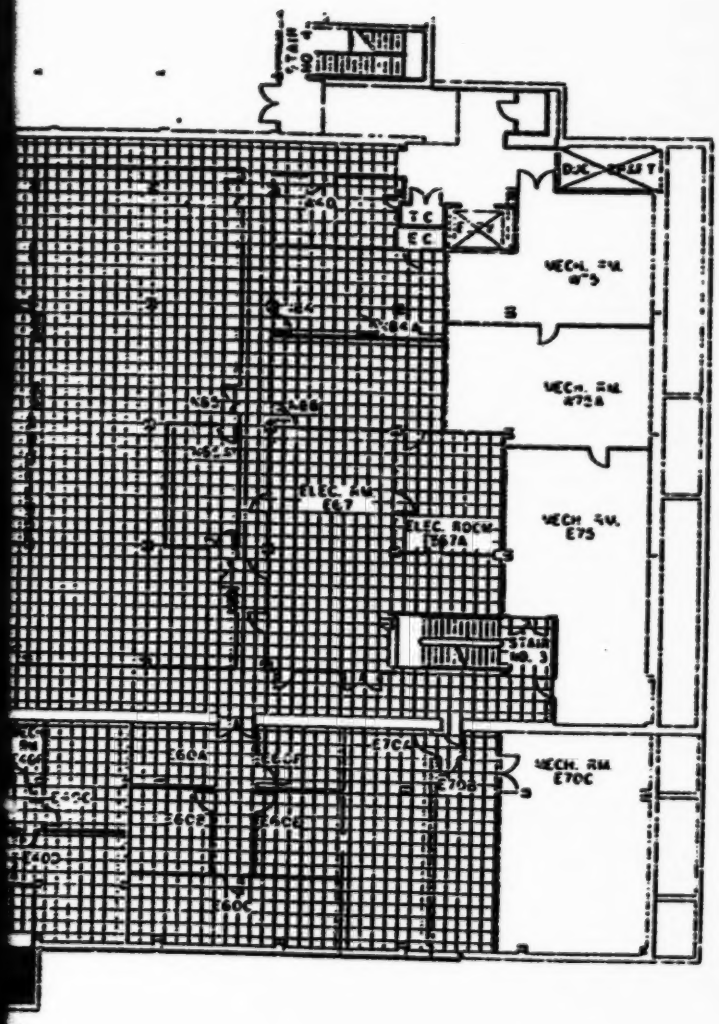


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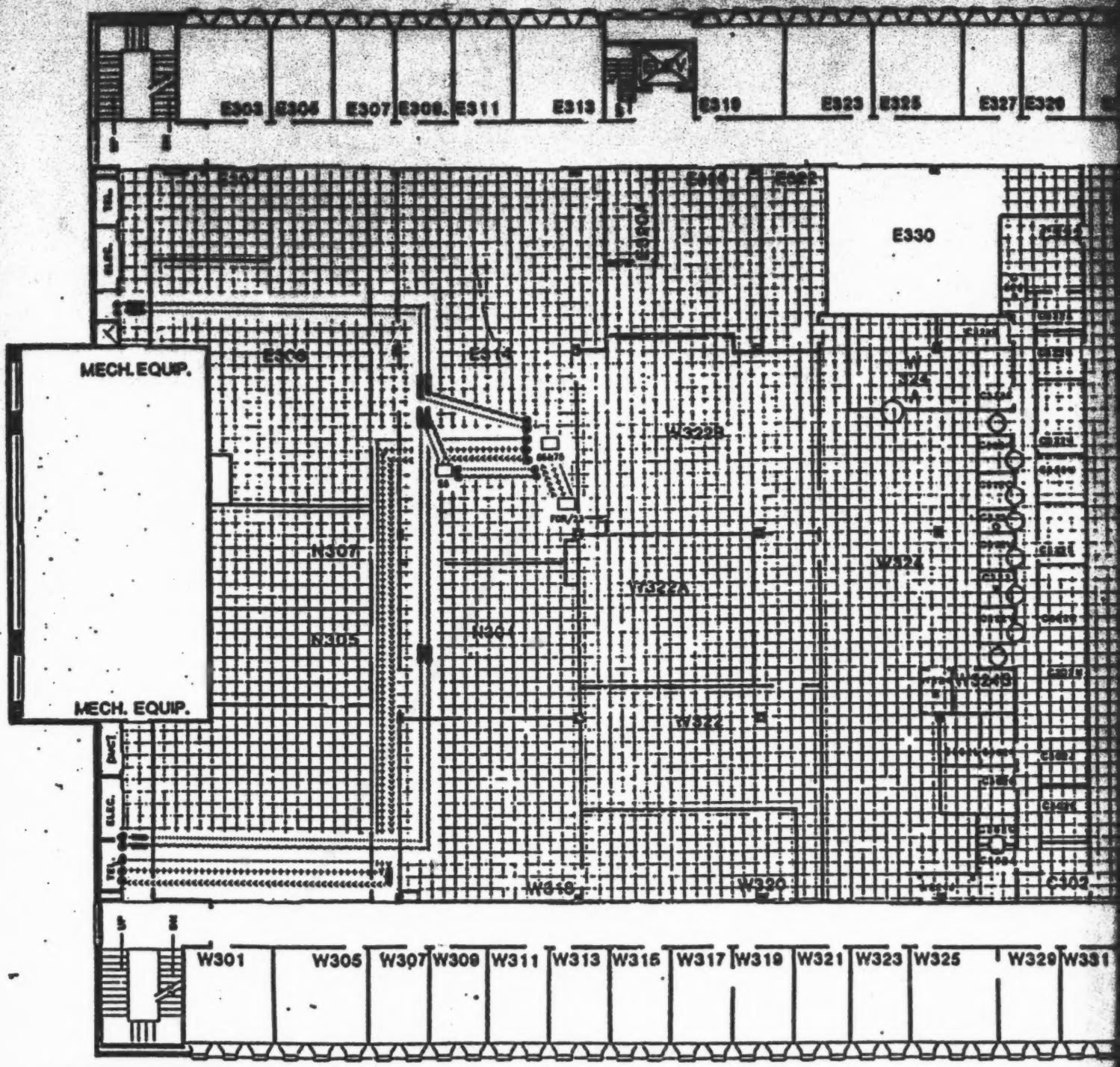


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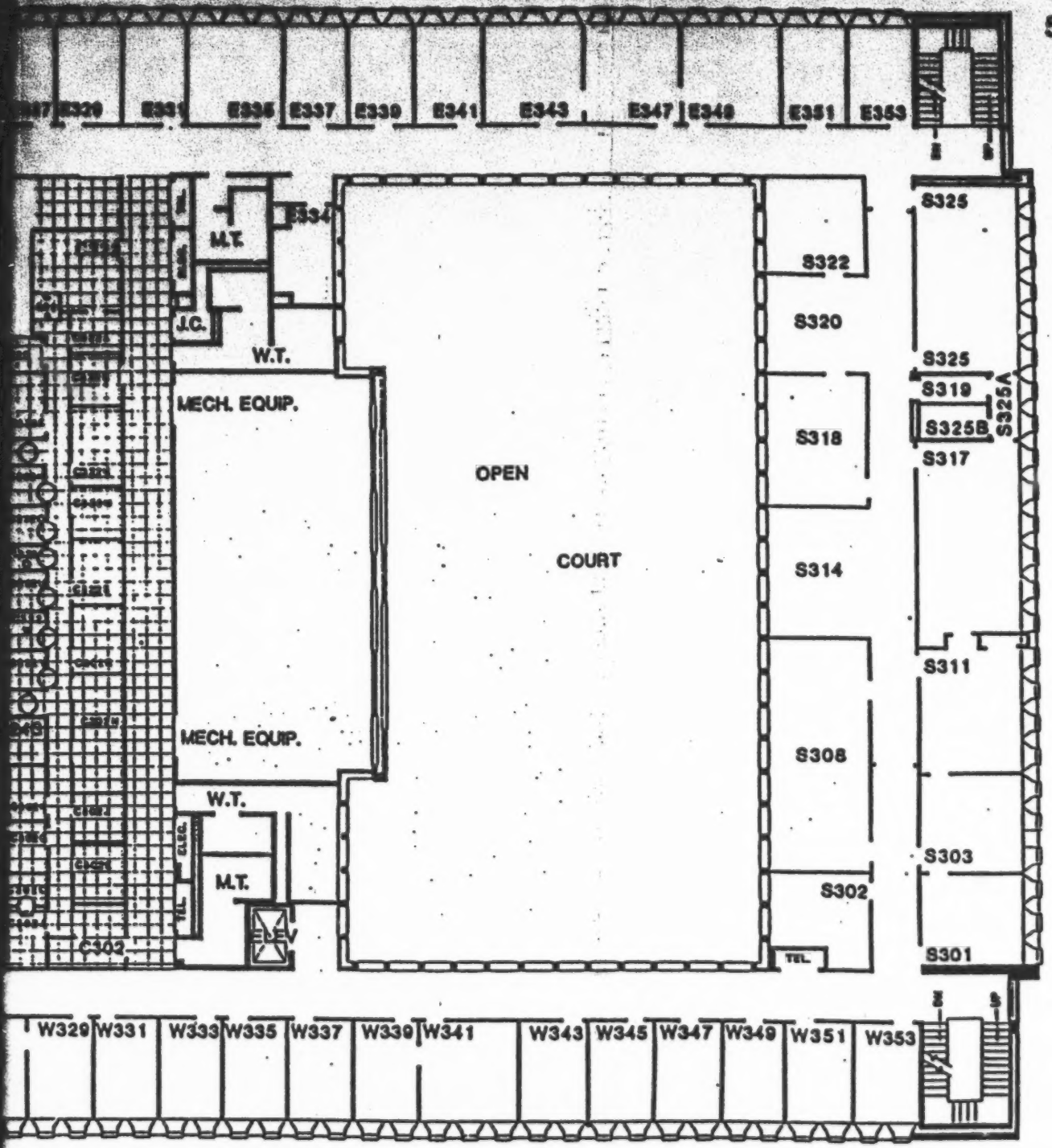


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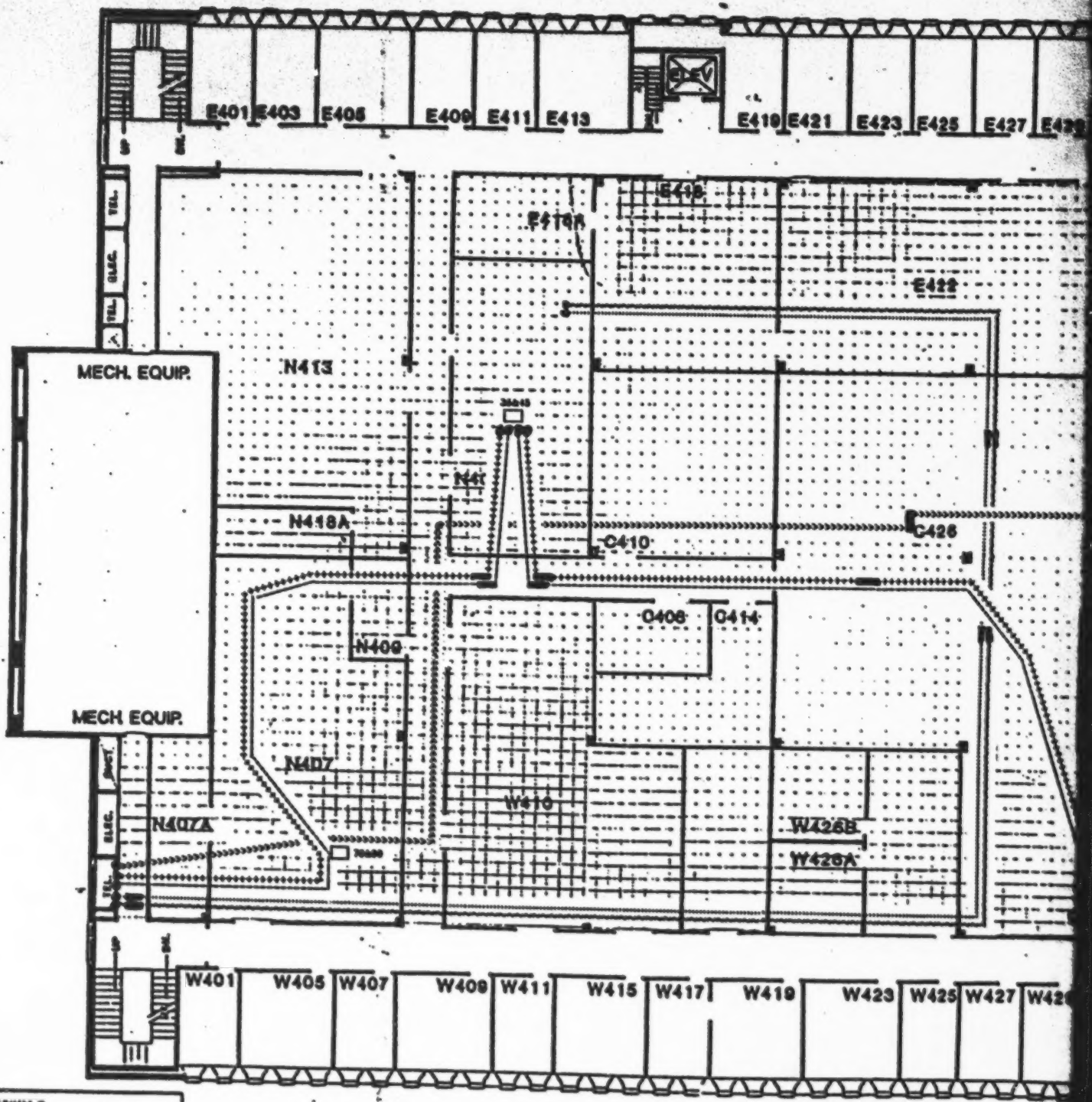


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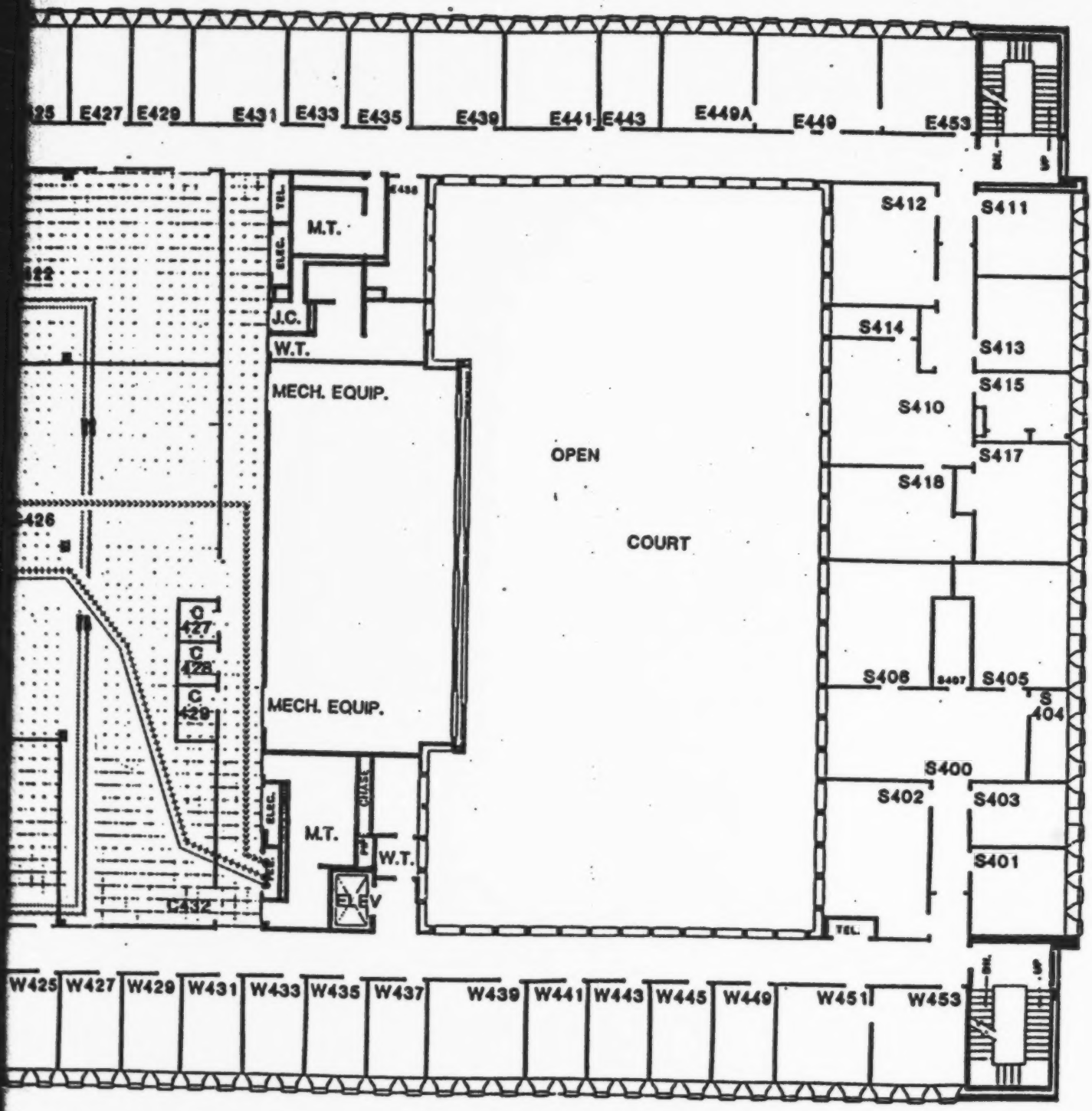


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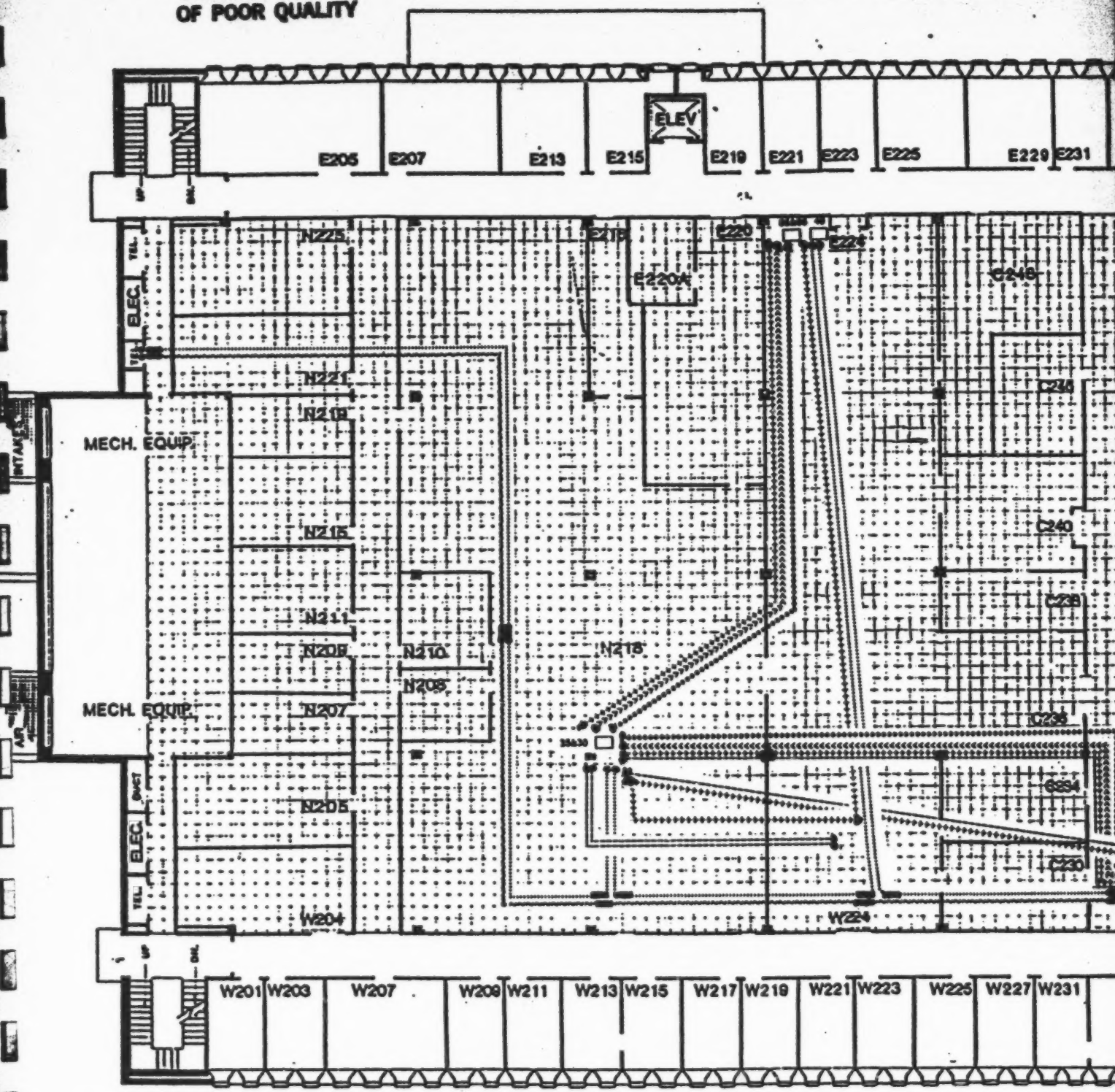


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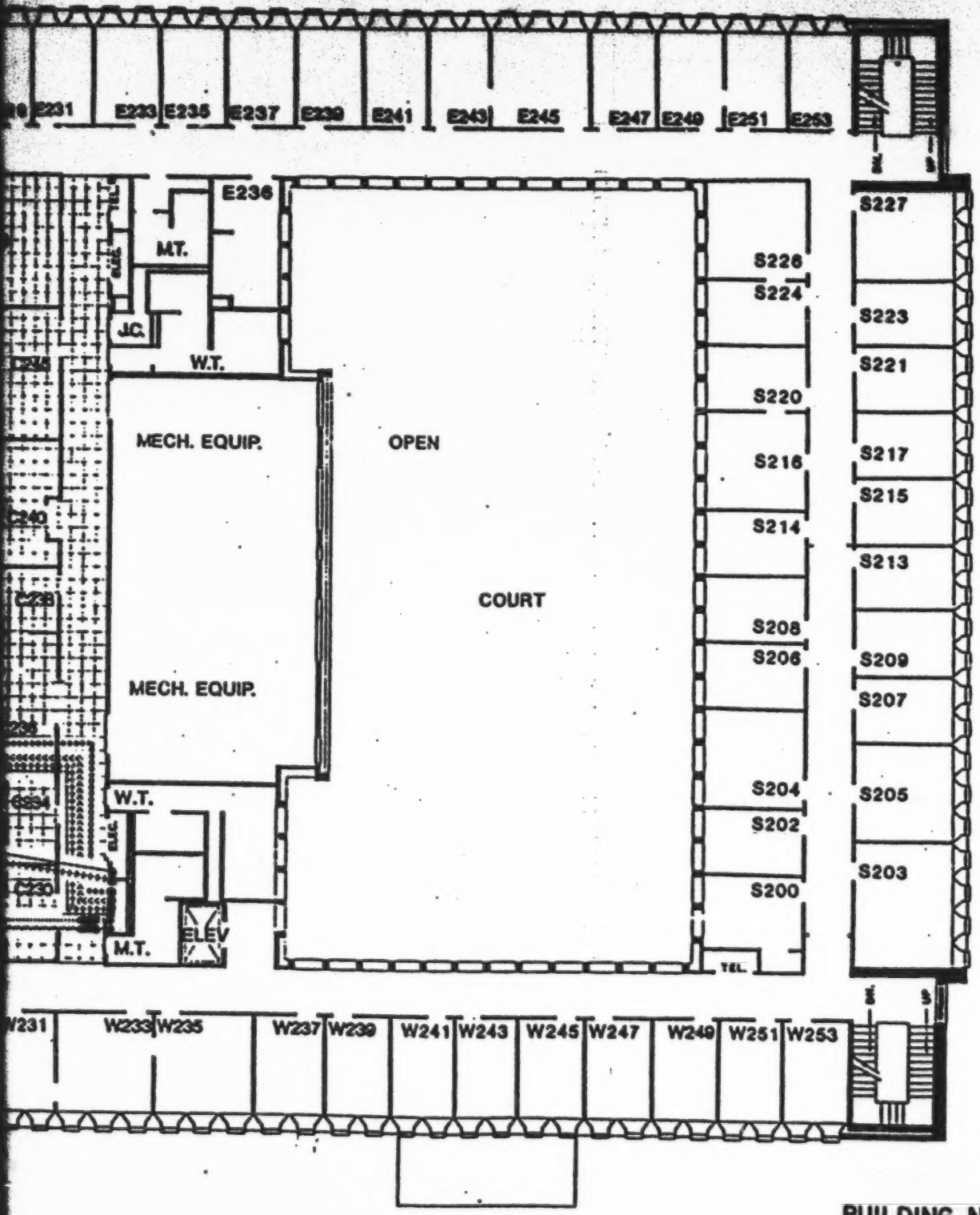


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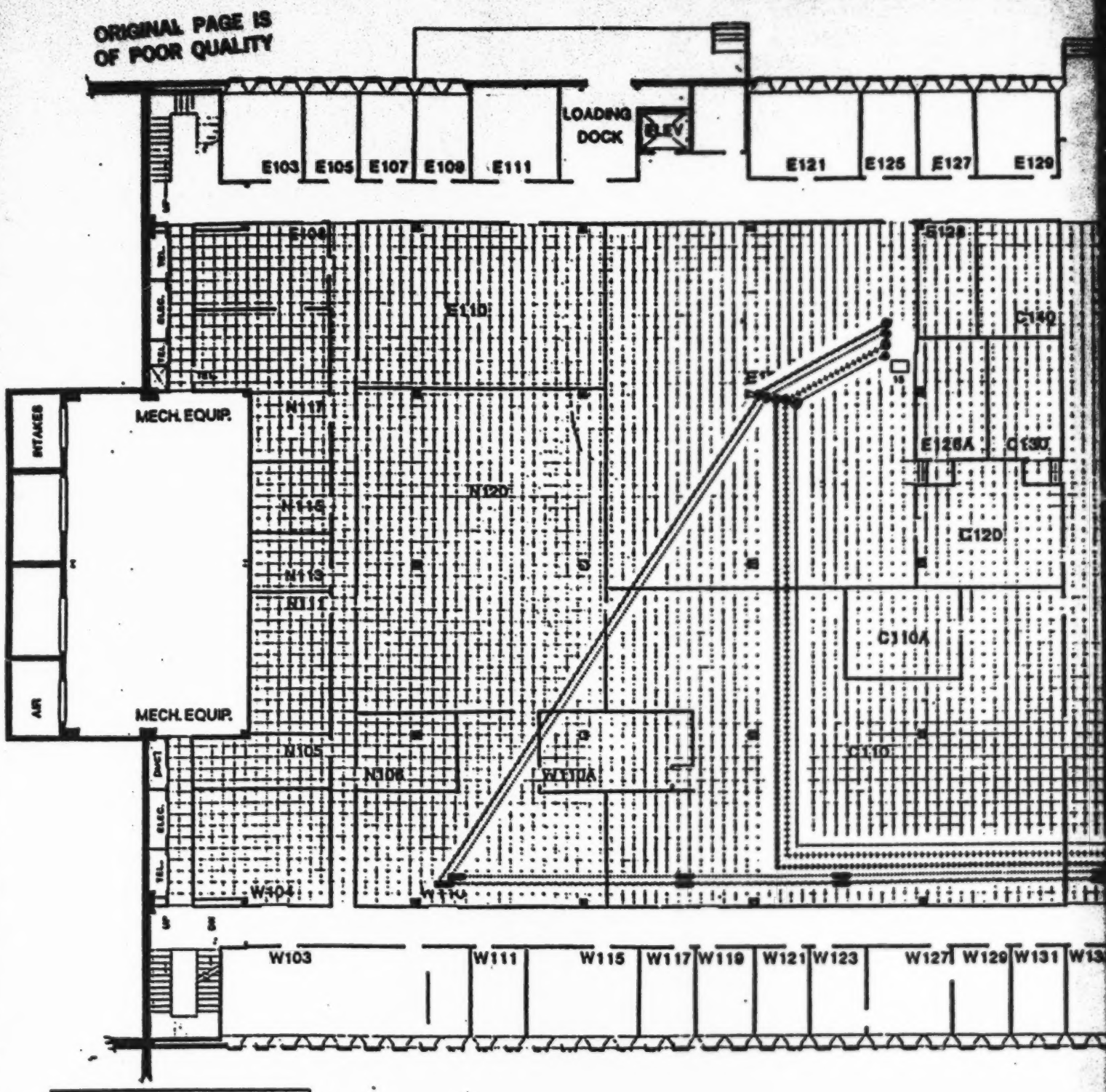


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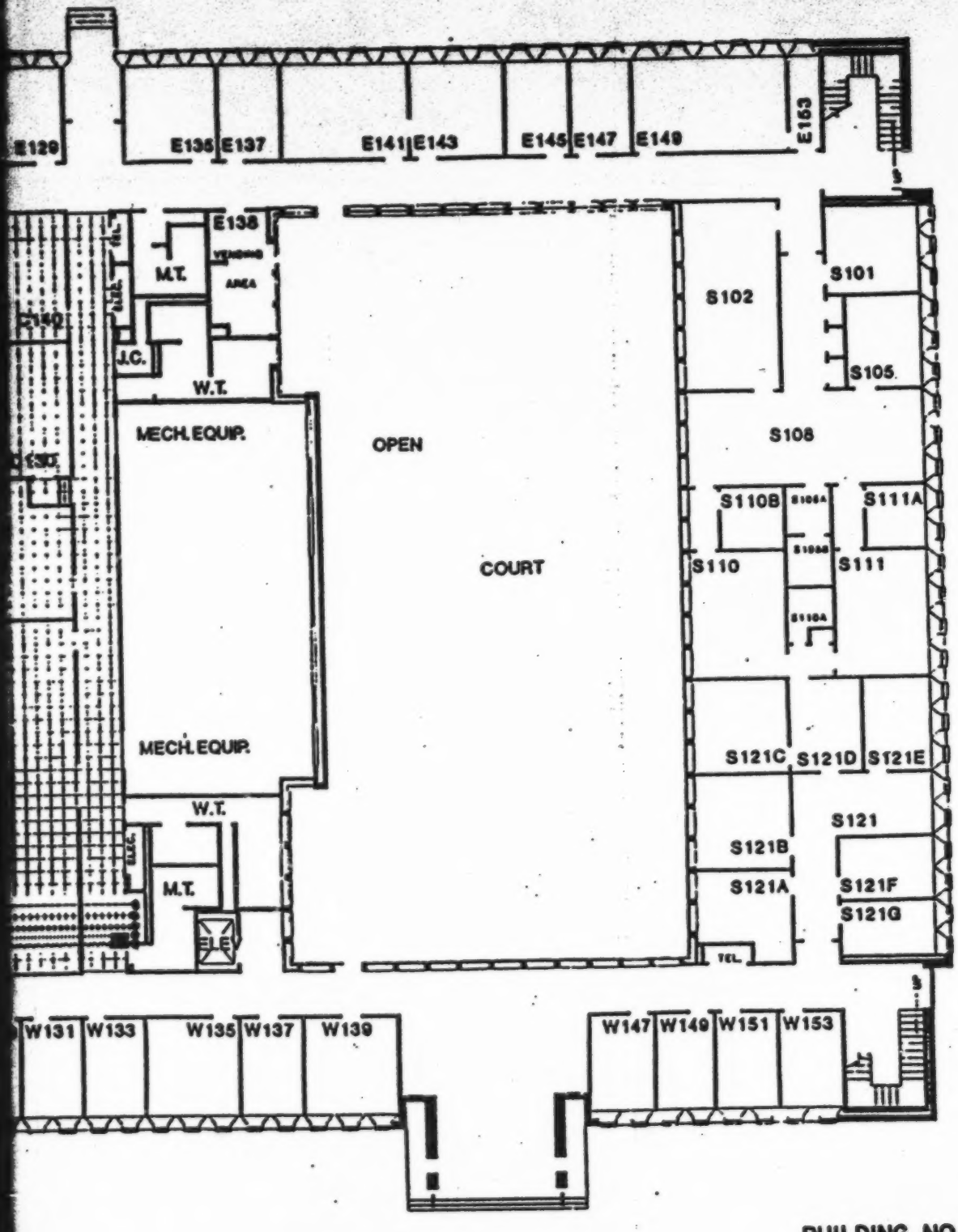


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